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CH-503

B. Tech.

(SEM. V) EXAMINATION, 2007-08

CHEMICAL REACTION ENGINEERING - I

Time : 3 Hours]   *[Total Marks : 100*

Note :   (i)   *Attempt all questions.*

(ii)   *Make suitable assumption for the data if missing.*

1   Attempt any four of the following : $5 \times 4 = 20$

(a)   The pyrolysis of ethane proceeds with   5
activation energy of about 75,000 cal. How
much faster is the decomposition at 650°C
than at 450°C ?

(b)   The reaction $H_2 + Br_2 \rightarrow HBr$ is supposed   5
to proceed by the following mechanism.

$$Br_2 \leftrightarrow 2Br$$
$$Br* + H_2 \leftrightarrow HBr + H*$$
$$H* + Br_2 \rightarrow HBr + Br*$$
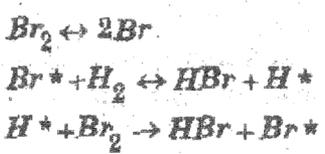
Find the rate expression for the formation of
the product HBr.

VK-9013]   1   [Contd...

4   Attempt any two of the following :   10x2=20

(a) The decomposition of A takes place by   10
     following series reaction

     $$A \xrightarrow{k_1} R \xrightarrow{k_2} S$$

     where R and S are the desired and undesired
     products. The order of the reactions for both
     the reactions are a and b respectively. What
     will be the concentration time curve for this
     reaction ? Discuss the conditions under which
     the yields of the desired product are increased.

(b) When do you prefer mixed reactors ?   10
     When is a plug flow reactor better than a
     CSTR ? Substantiate your argument with help
     of graphical presentation.

(c) Three equal size tanks are used in a series.   10
     An irreversible reaction with first order kinetics
     takes place in this reactor. Obtain the
     expression for conversion for the set of reactors
     in series.

5   Attempt any two of the following :   10x2=20

(a) What are the assumptions involved in tank   10
     in series model ? Obtain an expression for
     RTD using this model.

(b) What is adiabatic operating line for a   10
     reactor ? With the help of energy balance
     obtain the equation describing adiabatic
     conditions for first order reaction. Show
     graphically adiabatic operating lines for
     exothermic as well as endothermic reactions.

(c) Obtain an expression for mean residence   10
     time for CSTR. Write the assumptions
     involved in the derivation.